STATEMENT OF BASIS
(for Proposed Permit Limits (New Permit))

PERMITTEE: Ramshorn View Estates
Homeowner's Association
1 Riverview Lane
Gallatin Gateway, MT 59802

PERMIT NUMBER: MGWPCS-0103

RECEIVING WATERS: Ground Water

LOCATION: Northeast ¼, and N ½ Section 08, Township 07 South, Range 04 East, Gallatin County

FACILITY DESCRIPTION:

The discharge is domestic wastewater from two pressurized drainfields discharging 14,800 gallons per day (gpd) from 64 single family residences and 10 residences within a commercial lot. The residences are within the Ramshorn View Estates (RVE) subdivision. The location of the subdivision is illustrated on the attached map. The dimensions of the drainfields are 385 feet by 280 feet and 392 feet by 131 feet. The drainfields are located to the west of Highway 191 on a low alluvial terrace of the Gallatin River.

The geology of the RVE site in the area of the drainfields consists of Quaternary alluvium underlain by the Cretaceous Thermopolis Shale. The ground water table of the alluvial aquifer is approximately 13 feet below ground surface. The shallow ground water is recharged from the Gallatin river alluvium and surrounding unconsolidated sediments. The gradient of the ground water in the underlying shale formation is toward the shallow alluvial aquifer. The Gallatin River is a gaining stream in the area down-gradient of the drainfield. A hydraulic conductivity value of 1115 ft/day has been calculated for the Quaternary alluvial aquifer receiving the discharge. The RVE Homeowner's Association has applied for standard, 500-foot mixing zones for each of the two drainfields.

A. DISCHARGE LIMITATIONS

The NO3-N concentration in the drainfield discharge is estimated in order to determine whether the applicable nondegradation ground water quality limit can be met at the down-gradient edge of the mixing zones. A sensitivity analysis estimates the concentration of ground water nitrate plus nitrite as nitrogen (NO_3 + NO_2-N) that would result from the discharge. This estimate is derived from a dilution calculation according to the equation:

$$Cr = \frac{(Qd) \bullet (Cd) + (Qs) \bullet (Cs) + (Qr) + (Cr)}{(Qd + Qs + Qr)}$$

where: Cr = Concentration of nitrate in receiving ground water after mixing
Qd = Discharge volume
Cd = Discharge concentration
Qs = Ground water volume mixing with the discharge
Cs = Ambient ground water nitrate concentration

Qr = Recharge volume
Cr = Recharge NO3 + NO2-N concentration

The NO_3 + NO_2-N nitrate concentration assumed in the discharge, for the purpose of the nitrogen sensitivity analysis, is 24 milligrams per liter (mg/L). This concentration assumes 60 percent removal in the level two treatment applied to the effluent by the 1,500-gallon septic tanks discharging to recirculating sand filters before disposal to the drainfields. The total nitrogen concentration of the raw wastewater is assumed to be approximately 60 mg/L. The design manual for onsite wastewater treatment systems gives a range of from 35 to 100 mg/L for total nitrogen in untreated domestic wastewater (EPA 1980). The assumed raw wastewater nitrogen concentration for setting the permit limit is adjusted upward to 80 mg/L to account for the likely variability in the actual discharge.

The figure of 80 mg/L was chosen because it is the median value between the 60 mg/L concentration assumed in the nitrate sensitivity analysis and the 100 mg/L maximum concentration observed by EPA for typical residential dwellings using standard water fixtures and appliances. Applying the 60 percent removal assumption used in the nitrate sensitivity analysis, sets the concentration discharging from the drainfield at 32 mg/L. The drainfield is assumed to remove seven percent through biochemical transformations.of the nitrogen. Adding this level of removal to the drainfield discharge gives a dosing chamber concentration of 34 mg/L. This value is adopted as the permit concentration limit set on composite samples collected from the dosing tanks above the two drainfields.

The CS-1 design wastewater discharge volume (Qd) is 1,283 FT3/day. The groundwater volume mixing with the discharge is estimated using the Darcy equation :

Qs = K I A

where; Qs = ground water flow volume (FT3/day)
K = hydraulic conductivity (FT/day)
I = hydraulic gradient
A = cross-sectional area (FT2) of flow at the down-gradient boundary of a standard, 500-foot mixing zone.

The calculated value of Qs below the CS-1 drainfield is 77,332 FT3/day; assuming a measured aquifer K value of 1,115 FT/D, a measured gradient of 0.0125 and a cross-sectional area of 5548 FT^2. The ambient concentration of NO_3 + NO_2-N in the ground water (Cs) was determined to be 1.09 mg/L based on analysis of samples from on-site wells. It is assumed that the entire nitrogen load in the seepage effluent converts to nitrate and enters the ground water. The dilution equation mixing the discharge with the underlying ground water gives the following result for the nitrate concentration at the edge of the mixing zone:

$$Cr = \frac{(1{,}283\ FT3/day)\ (32\ mg/L) + (77{,}332\ FT3/day)\ (1.09\ mg/L) + (245\ FT3/day)\ (1.0\ mg/L)}{(1{,}283\ FT3/day + 77{,}332\ FT3/day + 245\ FT3/day)} = 1.59\ mg/L$$

The sensitivity analysis that also accounts for nitrate contributions from precipitation over the surface area of the drainfield, gives a ground water NO_3 + NO_2-N concentration of 1.59 mg/L after mixing. Because the drainfield discharge is small compared to the ground water flow, there is adequate dilution available, after mixing, to meet the applicable nondegradation limit of 7.5 mg/L for domestic wastewater systems using level II treatment. Corresponding mixing calculations for CS-2 yields a ground water NO_3 + NO_2-N concentration of 4.42 mg/L after mixing. The higher concentration for CS-2 is due to a higher background NO_3 + NO_2-N

concentration caused by the cumulative effects of up-slope single-family drainfields within the RVE subdivision.

The potential for migration of fecal coliform bacteria from the drainfield through the alluvium and into underlying ground water has been an issue in DEQ's review of the RVE application. The unsaturated zone beneath the drainfield is approximately 11 feet thick and may contain some fine-textured materials that would provide for bacteria and virus removal. The permit, however, contains a monitoring requirement for fecal coliform bacteria in wells MW-1 and MW-2 as a precaution due to the unknown extent of fine-textured sediments in the unsaturated zone and in the mixing zone portion of the aquifer. The pH limitation is imposed to ensure that the quality of the effluent is in the pH range that allows for proper biochemical function in the absorption field.

B. SELF-MONITORING REQUIREMENTS

Tables 1 lists the parameters, monitoring frequency and sample type specified in the permit for the effluent. The composite effluent samples from the dosing tanks for CS-1 and CS-2 are required to characterize the wastewater variability that is likely during a typical day of operation. Table 2 lists the parameters, monitoring frequency and sample type specified in the permit for the receiving ground water in wells MW-1 and MW-2. The well installations at the down-gradient edge of the mixing zones are required as a condition of this permit. The monthly measurement of the SWL during the first two years of the permit is required to determine the magnitude of seasonal fluctuations and determine whether and how these are related to water quality. After the first two years of the permit, SWL measurement is required during each sampling event. Ground water sampling is required quarterly to check compliance with standards.

Table 1. Parameters monitored in the discharges at the dosing tanks for CS-1 and CS-2.

Parameter	Frequency	Sample Type(1)
pH (s.u.)	Quarterly	Composite
SC (mhos/cm)	Quarterly	Composite
TDS (mg/L)	Quarterly	Composite
Cl (mg/L)	Quarterly	Composite
Total Kjeldahl Nitrogen (TKN) (mg/L)	Quarterly	Composite
NO_3+NO_2-N (mg/L)	Quarterly	Composite

(1) See definitions, in permit MGWPCS-0103, Part I.A

Table 2. Ground water monitoring parameters for wells MW-1 and MW-2.

Parameter	Frequency	Sample Type(1)
Static Water Level (FT)	Monthly	Instantaneous
pH (s.u.)	Quarterly	Grab
SC (mhos/cm)	Quarterly	Grab
TDS (mg/L)	Quarterly	Grab
Cl (mg/L)	Quarterly	Grab
NO_3+NO_2-N (mg/L)	Quarterly	Grab
Fecal Coliform Bacteria (Organisms/100 ml)	Quarterly	Grab

(1) See definitions in permit MGWPCS-0103, Part I.A

Ground water analysis for the parameters pH, SC, TDS and Cl are required to detect seepage effects in the monitoring wells. Analysis for NO_3+NO_2-N and fecal coliform bacteria are required to determine compliance with ground water nondegradation limits and human health standards respectively. The human health standard for fecal coliform bacteria is less than one organism per 100 milliliters.

C. PAST MONITORING DATA

The wastewater treatment system is a proposed source and no effluent samples have been analyzed. Ground water samples were collected from the artesian supply well on the property and . This ground water had a pH value of 8.6 and a total dissolved solids value of 670. The aquifer tapped by the artesian well, however, is not the aquifer that will be affected by the proposed wastewater discharge. Ground water from an on-site test well contained a NO_3+NO_2-N concentration of 0.69 mg/L in a sample collected 10-08-97.

Well 2 (the Walt Wolfe well), located 180 feet north of the artesian well had less than the 0.01 mg/L detection limit for nitrate nitrogen for a sample collected April 2, 1998. Other parameters measured in sample from Well-2 include pH (8.8) and specific conductance 1,700 µmhos/cm.

D. WASTEWATER TREATMENT AND MIXING

The discharge will receive treatment by removal of settleable and floatable solids in the primary septic tanks. The EPA (1980) has collected data suggesting a range of nitrogen removal in septic tanks from two to 10 percent. Forms of organic nitrogen are transformed to ammonia and mineralized to nitrate in the aerobic sand filter component. The filtrate is routed to a recirculation tank under anaerobic conditions that denitrify the effluent before its discharge to the dosing tank and soil absorption fields. Reported values for nitrogen removal in recirculating sand filter systems have ranged from 40 to 70 percent. A minor amount of nitrogen fixation can be assumed in the drainfield but total nitrogen reduction is not an important absorption field function.

The permit grants standard ground water mixing zones for each of the drainfields. The mixing zones are illustrated in Attachment 1 of the permit. The shape of the mixing zone is determined from dimensional criteria contained in ARM 17.30.517. Its location is determined from information on water table elevation and flow direction obtained from Morrison-Maierle, Inc. (1999). The mixing zones extend toward the northeast at 64° from the drainfields.

E. WATER QUALITY STANDARDS DISCUSSION

The proposed disposal system is a new source (ARM 17.30.702 (16)) and is subject to the nondegradation requirements (ARM 17.30.705 (1)). Ground water beneath the property is Class I. Class I ground water is suitable for public and private water supplies, culinary and food processing purposes, irrigation, drinking water for livestock and wildlife and for industrial and commercial uses. Secondary and human health standards apply to concentrations of dissolved substances in Class I ground waters. Nondegradation limits apply at the down-gradient mixing zone boundaries in the unconfined alluvial aquifer monitored at wells MW-1 and MW-2.

The discharges from the RVE subdivision were reviewed by the Subdivision Section of the DEQ Water Protection Bureau for compliance with the nondegradation limit for NO_3+NO_2-N and phosphorus. The review determined that the applicable NO_3+NO_2-N limit of 7.5 mg/L would not be exceeded at the mixing zone boundary and that the phosphorus absorption capacity of the soils and aquifer materials exposed to the discharge was sufficient to prevent a break-through of phosphorus in Gallatin River surface water within 50 years.

Prepared by: _____ Date :_____

References:

Environmental Protection Agency. 1980. Design Manual-Onsite Wastewater Treatment and Disposal Systems.

Morrison-Maierle, Inc. 1998. Determination of Significance for Ramshorn Subdivision, Big Sky, Montana.

Public Notice

APPLICANT NAME:	Ramshorn View Estates Homeowner's Association
APPLICANT ADDRESS:	1 Riverview Lane Gallatin Gateway, MT 59802
APPLICANT STATUS:	New Permit
FACILITY LOCATION:	Northeast ¼, and N ½ Section 08, Township 07 South, Range 04 East, Gallatin County
PERMIT NUMBER:	MGWPCS-1003
EXPIRATION DATE:	July 31, 2004

The discharge is domestic wastewater from two pressurized drainfields discharging 14,800 gallons per day from 64 single family residences and 10 residences within a commercial lot. The dimensions of the drainfields are 385 feet by 280 feet and 392 feet by 131 feet. The drainfields are located to the west of Highway 191 on a low alluvial terrace of the Gallatin River. The discharge occurs after removal of settleable and floatable solids in a conventional septic tank and removal of biochemical oxygen demand, bacterial and viral pathogens and nutrients in recirculating sand filters prior to disposal in the absorption fields. The discharge from the drainfields will contain elevated levels of total dissolved solids and nitrate plus nitrate as nitrogen. The tentative permit grants the discharges a standard ground water mixing zones extending 500 feet down-gradient of the source. The Department has determined that the discharges will not result in significant ground water degradation. The permit requires discharge monitoring and ground water monitoring.